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Conventional Combustion Environmental Assessment Program

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16. ABSTRACT

The brochure gives a generic overview of EPA's Conventional Combustion Environmental Assessment (CCEA) Program. The CCEA Program was established recently to coordinate and integrate EPA's research and development efforts for assessing the environmental effects of pollutants from the conventional combustion of fossil fuels. The brochure describes the CCEA Program: its objectives and methodology, why and how it was developed, and its outputs.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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WHAT IS CCEA?

CCEA is Conventional Combustion Environmental Assessment: A new program aimed at assessing the environmental, health, economic, and energy impacts of air, water, and solid waste pollution from stationary conventional combustion processes. Initiated by the U. S. Environmental Protection Agency's (EPA) Industrial Environmental Research Laboratory (IERL-RTP) in Research Triangle Park, North Carolina, CCEA assesses the impacts of emissions from industrial, utility, residential, and commercial combustion processes.

Begun in February 1977, the CCEA program has several functions:

Coordinating CCEA research and development projects to reduce duplication of effort and to increase the return from available resources

Compiling a CCEA information base

Using this information to develop an overall picture of the harmful health and environmental effects of combustion-related emissions

Providing CCEA activity reports and information transfer

Four ongoing IERL-RTP projects are included in the CCEA program:

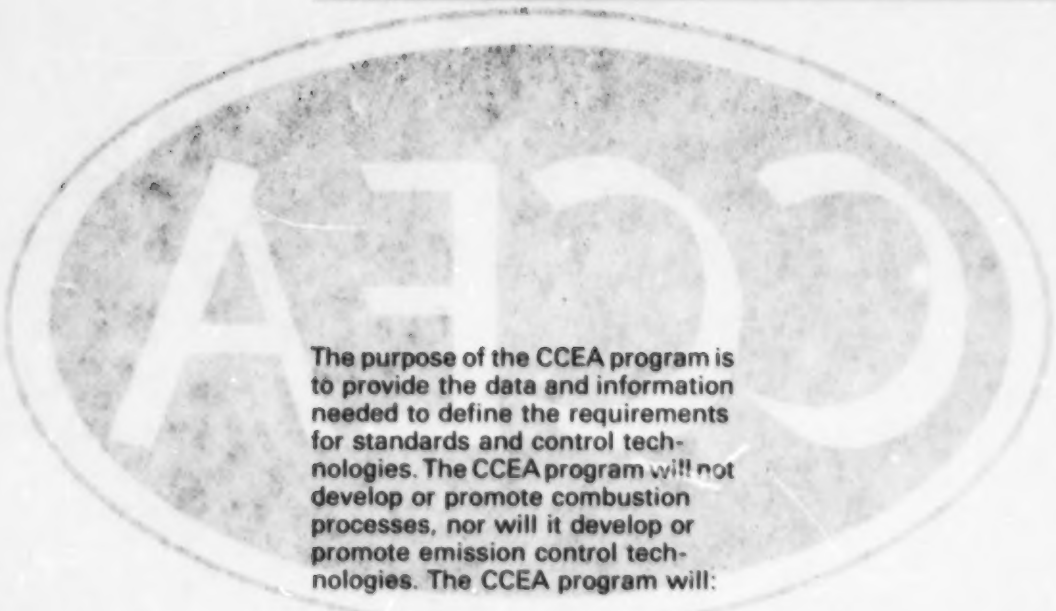
Characterization of emissions from conventional combustion processes

Environmental assessment of combustion modification for NO_x control

Environmental assessment of residual oil processing

Environmental assessment of liquid and solid waste streams from combustion processes and control technologies

WHAT WILL CCEA DO?



The purpose of the CCEA program is to provide the data and information needed to define the requirements for standards and control technologies. The CCEA program will not develop or promote combustion processes, nor will it develop or promote emission control technologies. The CCEA program will:

Determine the extent to which available information can be used to assess the total environmental, economic, and energy impacts of conventional combustion processes

Identify and acquire additional information needed for assessment

Define the requirements for modifying present control technologies or for developing new control technologies

Define the requirements for modifying existing pollution standards or for developing new standards to regulate pollutant emissions

The information and data identified and evaluated by these activities will provide energy and environmental decision-makers a basis for:

Setting standards,

Developing control technologies,

Formulating policies, and

Allocating resources

to ensure that expanding use of conventional combustion processes will not result in unnecessary harmful effects to human health, the ecology, and the general environment.

WHY IS CCEA NEEDED?

Conventional combustion processes provide most of the energy used in the United States today by industries, utilities, businesses, and homes. Emissions from these processes cause air pollution, water contamination, and land degradation. These environmental impacts pose serious threats to human health.

EPA and other concerned organizations have been studying the environmental problems of combustion for a number of years. Typically, these studies have had very specific objectives. In other words, they have identified emissions from selected processes, examined the health and environmental effects of a specific compound, or developed the technology to control specific air, water, or solid waste pollutants. The impacts of combustion-related pollutants, however, are not separate and distinct. A single air pollutant may react in the atmosphere to form other compounds that may be as harmful as the original compound. The air pollutant may react with moisture in the atmosphere, fall to earth in rain, contaminate water supplies, or in other ways damage the environment. Potentially, human health can be affected by any or all of the various forms that this pollutant can have in the environment.

Very few, if any, studies to date have attempted a comprehensive examination of the total impact of pollutant emissions from conventional combustion processes. Coordination and information exchange between efforts have also been lacking. The CCEA program will fill these gaps by providing a systematic, coordinated structure that ties together the separate data generated by past and ongoing work to provide a comprehensive environmental assessment of conventional combustion processes.

HOW WILL CCEA WORK?

The CCEA program was developed by expanding a previously established definition of environmental assessment of fossil fuel-fired combustion processes. This definition, derived by IERL-RTP describes an environmental assessment as an iterative study to develop a basis for ranking environmental problems and control needs by:

Determining comprehensive environmental effects and control costs by applying sets of control or disposal options to particular sources, processes, or industries, and

Comparing these effects with existing standards, estimated environmental goals, and anticipated health impacts.

The CCEA program extends this definition to include the identification and assessment of the full range of health, ecological, and environmental effects. Thus, consideration is also given to socio-economic and institutional effects, and cross-media impacts and trade-offs.

CCEA is carried out simultaneously with technology development to identify and evaluate the full range of impacts of combustion processes and/or control technologies on the environment.

The nucleus of the CCEA program is a comprehensive CCEA methodology that allows more than 200 different types of information to be systematically identified, evaluated, and compiled. This methodology is designed to provide an expanding information base that can be used to respond to a vast array of questions:

What air, water, and/or solid waste pollution results from combustion processes and associated control technologies?

What are the health effects of these combustion process emissions?

What effects do the emissions have on the ecology? On air, land, and water quality?

What laws exist to control the pollutant?

What are the emission or ambient level goals for the pollutant?

How much of the pollutant already exists in the atmosphere?

What environmental goals and objectives exist or should be developed for the pollutant?

Are these goals currently being met?

What is the total estimated impact of this pollutant?

How critical (in terms of quantity and severity) is this impact?

What control options are available?

Are available controls adequate to meet the environmental goals and objectives?

The CCEA methodology responds to the CCEA goals and provides input to a detailed procedure to analyze and compare the programmatic contents of CCEA-related research and development projects.

The CCEA methodology consists of five* basic steps:

Characterize combustion process and emissions

Identify health and ecological effects

Develop environmental goals and objectives

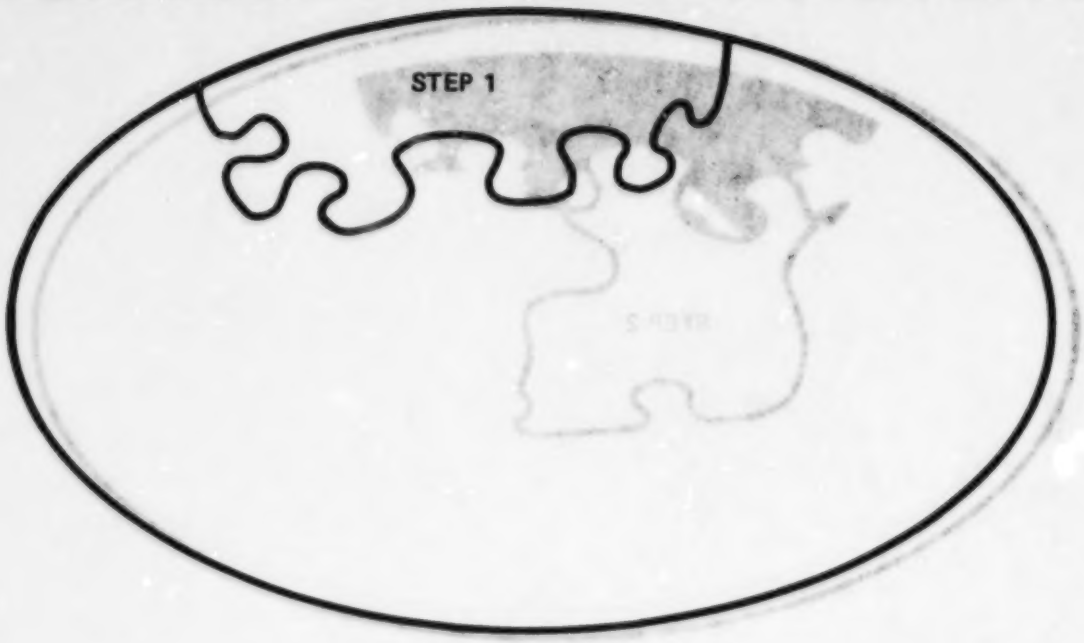
Quantify the total pollutant impact

Evaluate control alternatives

Application of the CCEA methodology and of the analysis procedure yields findings that provide a basis for establishment of standards, development of control technology, policy formulation, and resource allocation.

**The CCEA methodology is described alternately in other publications as a three step procedure. The five steps presented here are equivalent and do not imply change in the methodology.*

STEP 1



The first step in CCEA is to identify and define the potential pollutants emitted by the stationary conventional combustion process. This step involves examination of both the combustion process and associated emissions. CCEA has established five separate categories to provide the data required for this essential first step:

Process Technology Characterization — provides detailed technical and operational information on the conventional combustion process

Fuels Characterization — describes the fuel type, source, physical form, energy content, availability, methods of delivery and storage, chemical composition, and potential pollutants.

Input/Output Characterization — establishes the relationships among the process variables so that potential pollutant loadings can be calculated

Standard Sampling and Analysis Techniques — ensure consistent and reliable results for comparison of data obtained by various investigators

Field Tests and Surveys — quantify and characterize the effluents using standard sampling and analysis techniques

STEP 2

The second step in CCEA is the identification of the health and ecological impacts of the potential pollutants identified in Step 1. This step involves detailed analysis of the environmental response and the state of health of the population exposed to a pollutant. Five areas of investigation provide input to this step:

Ecological Impacts Data — establish ecology-related impacts (including the effects on air, water, and land quality) and quantify the total ecological degradation

Dose-Response Data — allow translation of environmental pollution concentrations into estimates of the number and types of specific biological impacts (e.g. respiratory disease or cancer) to be expected in the exposed population

Pollutant Transport, Transformation, and Fate Models — provide estimates of pollutant concentrations and exposure levels and include meteorological, hydrological, and pollutant transformation/reactivity data

Bioassay Data — identify the effects of varying concentrations of pollutants on living organisms

Epidemiological Data — are developed from occupational exposure-related health information and serve as important indicators of potential adverse pollutant impacts

STEP 3

Environmental goals and objectives are developed in Step 3. These goals and objectives are standards of acceptability that are based on a variety of interrelated factors:

Statutory Constraints — include all existing Federal and State standards and regulations pertaining to air, water, and land quality, including the National Primary and Secondary Air Quality Standards, State Implementation Plans, New Stationary Source Performance Standards, and National Interim Drinking Water Regulations

Emission or Ambient Level Goals — are based on control technology capabilities to limit emissions or on ambient factors that reflect the health and ecological impacts of the pollutant

Social/Economic/Political/Institutional Considerations — include a variety of quantitative and qualitative data such as the impact of the combustion process on land and water, energy use patterns, social/cultural patterns, regional and national economy, aesthetics, siting criteria, and critical materials impacts

Ambient Pollutant Levels — are determined by extensive data collection and evaluation and are considered in setting such environmental goals as "no significant deterioration"

IERL-RTP has established a format for evaluating this information in order to develop measures of acceptability for each pollutant. These measures of acceptability are known as Multimedia Environmental Goals (MEG's). About 650 compounds are currently on the MEG list. CCEA explores all of the MEG compounds as well as compounds not on the MEG list.

Once Step 3 has been completed, the health and ecological impacts identified in Step 2 are compared with the goals and objectives developed in Step 3. If the health and ecological impacts are:

ACCEPTABLE — the CCEA is complete

QUESTIONABLE — the data base is refined and/or reevaluated

UNACCEPTABLE — the magnitude of the impacts is established in Step 4

STEP 4

The potential harm to be expected from the identified combustion-related pollution must be quantified in order to be useful. Step 4 develops data and severity indices used to establish Pollutant Priority Rankings that aid in establishing standards or control needs. CCEA assesses the magnitude of pollution impacts by analyzing the following categories of data:

Combustion Process Use Projections — determine the current and projected number and distribution of the combustion process and provide information for total pollutant load calculations

Synergistic and Multimedia Impacts — identify potential impacts beyond the initial impact (for example, water or land contamination from air pollution)

Total Pollutant Load Calculations — determine the amount of the identified pollutant that is expected to occur in the atmosphere both naturally and as a result of man-made sources, including the combustion process

Regional Geographic Data — include regional population growth projections, local hydrology, and local meteorology

STEP 5

Step 5 of CCEA is identification and evaluation of the alternative methods available to reduce the identified deleterious environmental impacts. This Step permits selection and implementation of the best control strategy. Heavily dependent on the results of Steps 1 - 4, this Step requires consideration of a variety of information:

Control Alternatives — include existing control technologies and technologies expected to be available in the near future, as well as other options such as combustion modification and fuel switching/mixing

Control Strategy Environmental Impacts — are evaluated to identify any environmental problems associated with a control technology

Control Strategy Evaluation — determines the best pollution control alternative for a particular pollutant, emission stream, or combustion process, and includes consideration of removal efficiencies, availability, economics, and any energy penalties

HOW WAS CCEA DEVELOPED?

In order to develop the CCEA program, IERL-RTP devised an approach that consisted of eight discrete tasks:

Develop goals and objectives for unified CCEA program

Review existing IERL-RTP CCEA studies

Identify and evaluate related studies by other organizations

Separate relevant activities of existing studies into environmental assessment functional categories

Recombine relevant study activities within environmental assessment categories

Maintain current information base

Evaluate the integrated existing CCEA effort

Develop the unified CCEA program plan

More than 500 ongoing and recently completed CCEA-related studies were identified within EPA, other Government agencies, and nonprofit organizations. Due to the large number of studies, a manageable set of 13 "core" studies was initially integrated into the unified CCEA to demonstrate the methodology.

Examination and separation of this "core" set was performed with the aid of an information checklist outlining the major elements of the CCEA program. A code corresponding to the elements of CCEA was developed and applied to the information checklist. Information from each of the selected studies was then coded to complete a CCEA program matrix. Other studies will be integrated into the matrix as resources become available.

The CCEA planning effort is essentially complete and has yielded four major products:

An initial set of CCEA program goals and objectives

The CCEA methodology

Detailed analytical procedures for identifying, evaluating, and integrating detailed information from pertinent research and development projects

A set of recommendations for implementing and managing the CCEA program

WHAT WILL BE THE RESULTS OF CCEA?

The CCEA program will yield comprehensive information on the impacts of combustion processes and associated control technologies. These data will provide valuable input to technological and managerial decision-makers for consideration in policy decisions, standards setting, and evaluation of research and development needs.

Recommendations for standards and control technology modifications and/or development are the major result of CCEA.

STANDARDS DEVELOPMENT RECOMMENDATIONS are made when impacts of combustion process emissions are determined to be harmful to human health or the environment and no government standards exist to control these impacts. The recommendations for standards, ranked in order of priority and justified by specific data, include information on the amount of control desirable and a time-frame for promulgation

CONTROL TECHNOLOGY DEVELOPMENT RECOMMENDATIONS are made when available control methods are inadequate. These recommendations are also ranked in order of priority and are justified by engineering and environmental data. Control technology development recommendations are accompanied by specific information on the amount of control required and on developmental requirements, costs, and schedules

In addition to these recommendations, CCEA provides other outputs that accompany the achievement of intermediate objectives or that fill the need for information transfer. Such outputs include:

- **Comprehensive information bases on CCEA-related research and development efforts**
- **CCEA reports**
- **Symposia**
- **A combustion-related samples archive**

IERL-RTP'S CCEA PROGRAM IS

A unified approach to solving the pollution problems that accompany our dependence on conventional combustion processes.

A coordinated effort that examines the air, water, and solid waste impacts of combustion processes.

An attempt to protect our health and our air, water, land resources from combustion pollutants while considering the energy and economic costs of protection.

If you would like additional information on the CCEA program, please contact:

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